RESULTS OF THE MGB LANDSLIDE AND FLOOD ASSESSMENT (1:10,000 SCALE) OF PARTS OF BOSTON IN THE PROVINCE OF DAVAO ORIENTAL

Due to the effects of Typhoon Pablo in some parts of Region XI, the Mines and Geosciences Bureau-Department of Environment and Natural Resources Regional Office No. 11 (MGB-DENR XI) prioritized the conduct of landslide and flood assessment and mapping (1:10,000 scale) of areas within the Municipality of Boston, Davao Oriental on February 11 to 26, 2013 being one of the worst hit areas. The assessment is in line with the government's efforts aimed at reducing, if not, totally mitigating the destructive effects and impacts of natural hazards on the populace. Comprising the geohazard assessment team are Ms. Beverly Mae M. Brebante, Ms. Abigail June L. Agus and Mr. Allen June B. Buenavista, geologists; Mr. Virgilio C. Torcido, geologic aide, and Mr. Pedro P. Calunsag , driver, all from the MGB regional office.

The team covered all the barangays of the municipality. Moreover, in addition to the geohazard assessment down to the purok and sitio level, the activity also included assessment of proposed relocation sites on its suitability to land development in relation to the permanent shelter program of other National Government Agencies, Local Government Units and International and National Non-Government Organizations (*Result is presented in a matrix below)*.

The assessed areas were rated as having low, moderate, high or very high (critical) susceptibility to landslide and were also evaluated and rated as low, moderate or high susceptibility to flooding.

The landslide susceptibility rating parameters are as follows:

Very high: Areas usually with steep to very steep slopes and underlain by weak materials. Recent landslides, escarpments and tension cracks are present. Human initiated effects could be an aggravating factor.

High: Areas usually with steep to very steep slopes and underlain by weak materials. Areas with numerous old/inactive landslides.

Moderate: Areas with moderately steep slopes. Soil creep and other indications for possible landslide occurrence are present.

Low: Gently sloping areas with no identified landslides.

The flood susceptibility rating parameters are as follows:

High: Areas likely to experience flood heights of greater than 1 meter and/or flood duration of more than 3 days. These areas are immediately flooded during heavy rains of several hours; include landforms of topographic lows such as active river channels, abandoned river channels and areas along river banks; also prone to flashfloods.

Moderate: Areas likely to experience flood heights of 0.5 to 1 meter and/or flood duration of 1 to 3 days. These areas are subject to widespread inundation during prolonged and extensive heavy rainfall or extreme weather condition. Fluvial terraces, alluvial fans, and infilled valleys are areas moderately subjected to flooding.

Low: Areas likely to experience flood heights of less than 0.5 meter and/or flood duration of less than 1 day. These areas include low hills and gentle slopes. They also have sparse to moderate drainage density

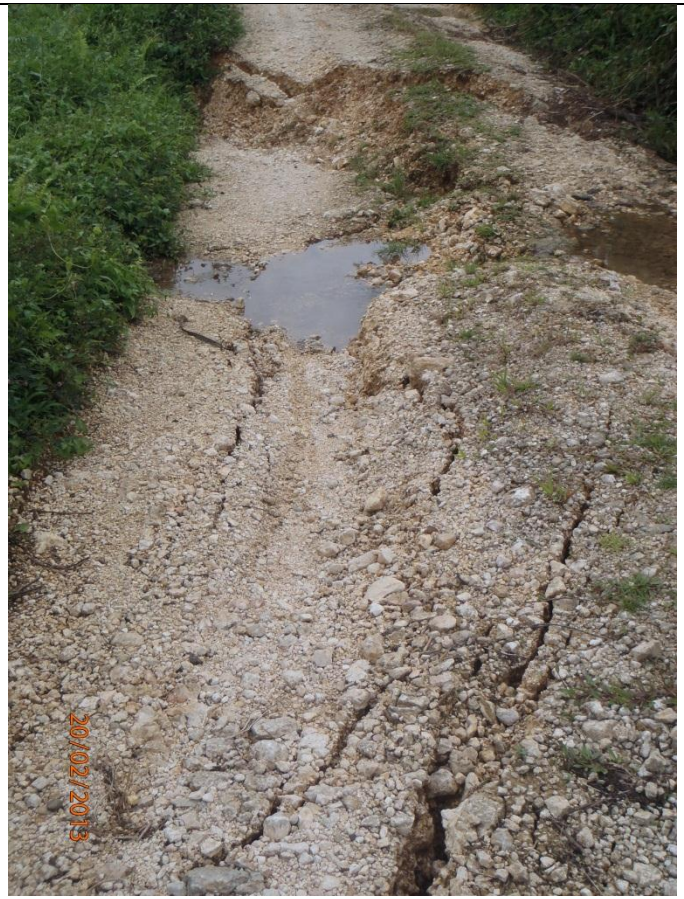
When appropriate, the barangay official/s were presented with a *Landslide/Flood Threat Advisory.* This advisory informs them of their area's susceptibility to landslides and contains the corresponding recommendations.

Below summarizes the results of the landslide and flood assessment of the covered areas:

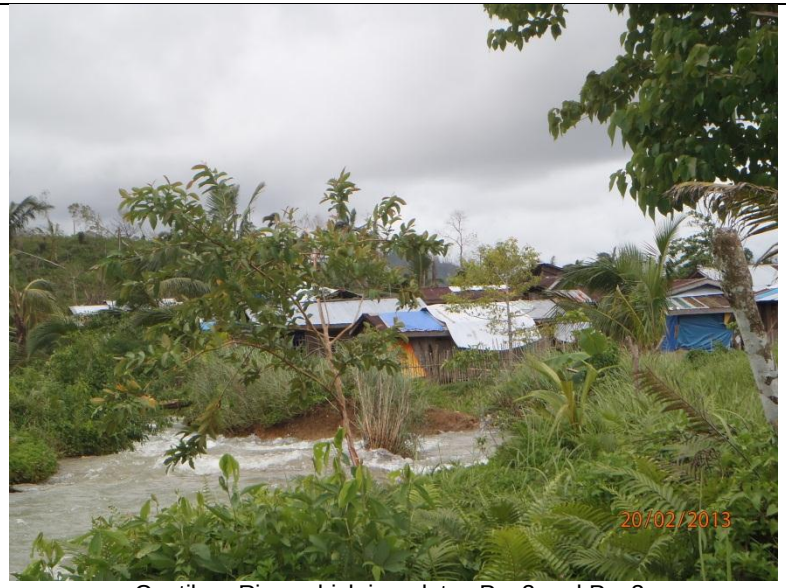
MUNICIPALITY OF BOSTON, DAVAO ORIENTAL

BARANGAY/PUROK/ SITIO	LANDSLIDE SUSCEPTIBILITY	FLOODING SUSCEPTIBILITY	REMARKS/RECOMMENDATION
CAATIHAN			
Purok 1	None	Low	Debris flow noted south of Caatihan along the road going to Simulao • Monitor progress of existing landslide/presence of new slope failures • Report to MGB or other authorities on critical conditions for appropriate action • Immediate removal of debris material that may dam creeks/natural drainages Flood height of 0.7m during Typhoon Pablo affecting portions of Po. 2 and Po 3 near Caatihan River; ES was also reached by flood water; floodwater subside after 1 day; scouring present at the outer bends of the meander; water in Biasong creek also overflowed on the bridge; Type of flooding is sheetflood • Relocation of houses particularly in Purok 2 and 3 that is regularly flooded • Installation of proper drainage system (depth and width of canals should take into account the maximum surface runoff
Purok 2	None	Moderate along Caatihan River	
Purok 3	None	Moderate along Caatihan River	
Purok 4	None	Low along Biasong River	
Purok 5	Moderate	None	
So. 5M	Very High	None	Small-scale mining activities exist in the area; tunnels noted; earthflow noted along the road (5M-Mangagoy route); area is bounded by faults • Relocation of So. 5M • Installment of warning sign along the road where debris flow was noted to warn motorists • Monitor progress of landslide and presence of indications of slope failures such as terracets, occurrence of spring, etc.

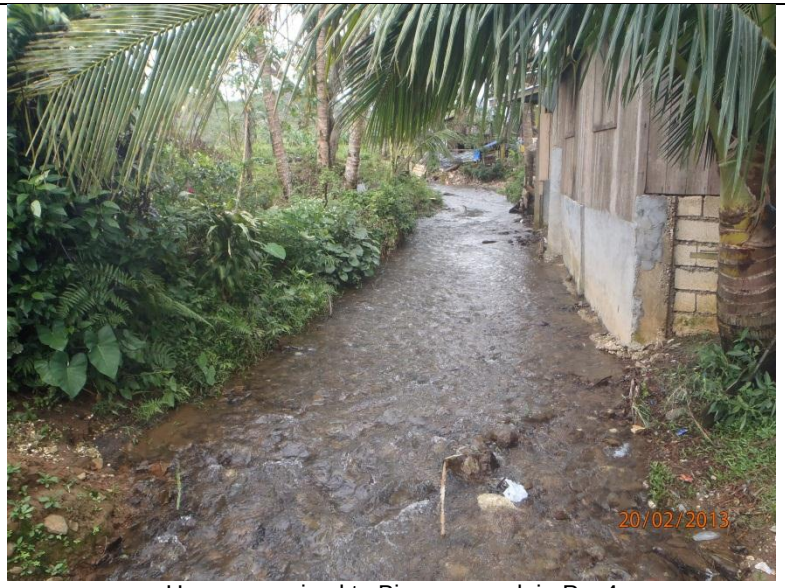
Earth flow noted along the barangay road to Brgy. Simulao.
(*Looking northeast; GPS Location: 7°53'18.824"N and 126°16'45.12"E)*



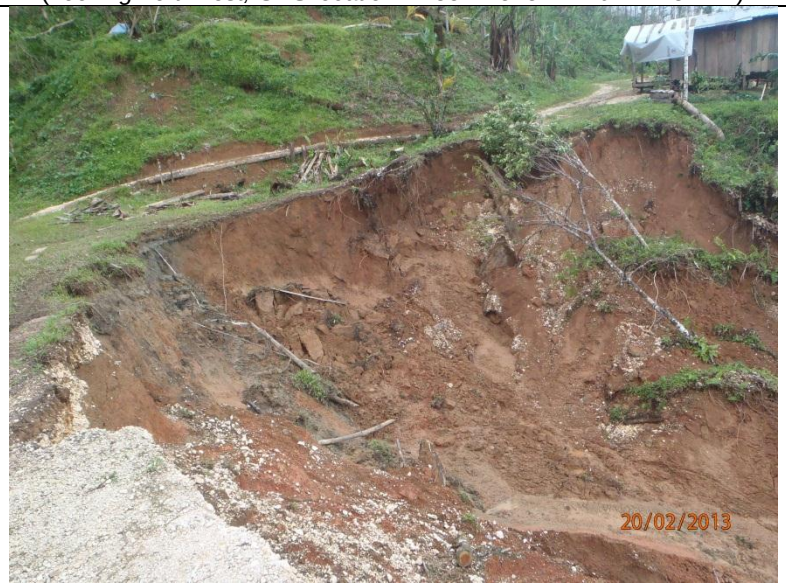
Tension cracks noted along the road going to So. 5M, Vertical displacement of 10 cm and horizontal displacement of 5 cm. Surface water is noted to seep into the cracks
(*Looking southwest; GPS location: 7°54'37.438"N 126°18'33.114"E*)



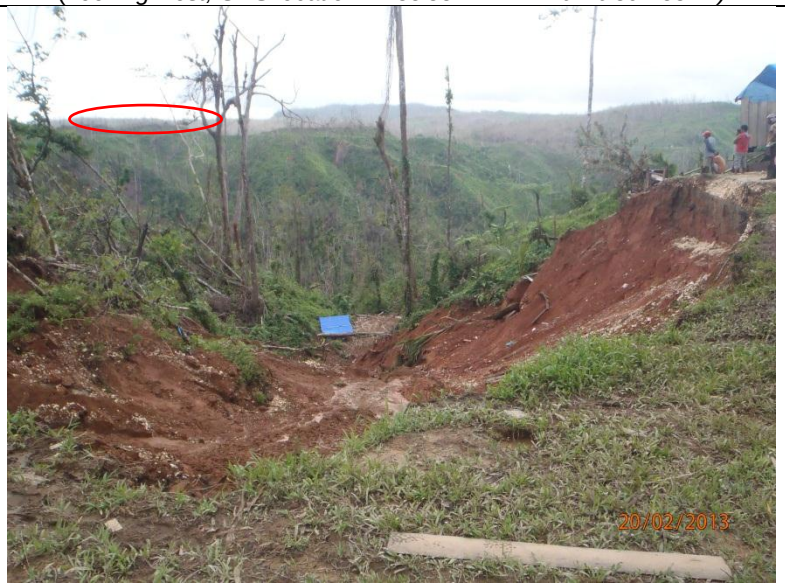
Caatihan River which inundates Po. 2 and Po. 3.
(*Looking northwest; GPS location: 7°53'44.313"N 126°17'7.541"E*)



Houses proximal to Biasong creek in Po. 4
(*Looking west; GPS location: 7°53'55.121"N 126°16'59.435"E)*



Earth flow in So. 5m along the barangay road
(*Looking southwest; GPS location: 7°55'54.464"N 126°18'9.746"E)*



Proposed relocation site of So. 5M
(*Looking north; GPS location: ~ 7°57'0.114"N 126°18'21.738"E)*

PROPOSED RELOCATION SITE

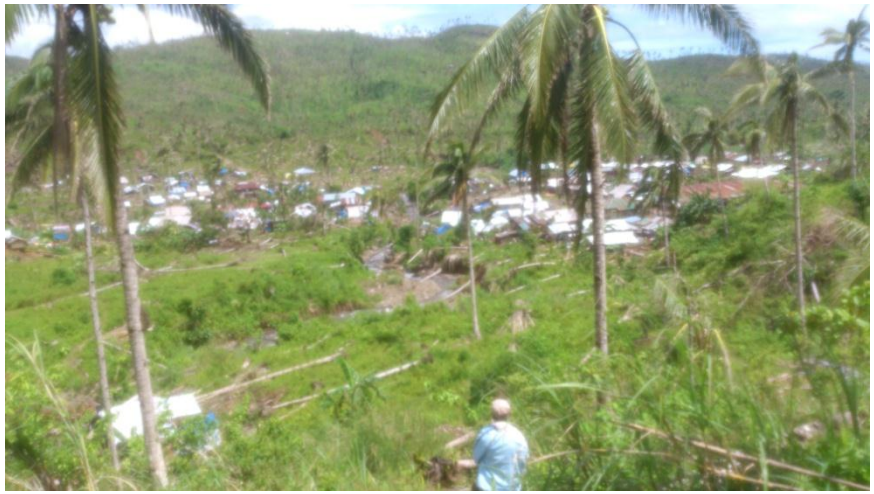
Site 1. The area is about 200 meters north-northeast from the barangay hall. The 3-has property is a titled lot owned by Mariana *Quilat*, Mariano *Cotic*, Antonio *Cotic* and Rolando *Ingbino*. The site is characterized by flat to nearly flat terrain and bounded by Caatihan River to the west which serves as the main natural drainage of the barangay. It flows in a north-south direction and drains to Simulao River in the north. The underlying material of the property is composed of clay and silty clay, thus, ponding of water is present due to low infiltration capacity of the soil. The site is suitable for resettlement area but certain recommendations must be applied, to wit: **a)** installation of proper drainage system taking into account the maximum surface runoff in the area and its vicinities; **b)** establishment of buffer zone of about 10 meters from the bank of Caatihan River; **c)** installation of creek bank protection such as gabions at the outer bend/meander of Caatihan River to prevent further scouring and erosion of the riverbank; **d)** Run-off from the intermittent creeks to the east must also be monitored and directed to channels away from the proposed site, and **e)** construction of berms or levees along Caatihan river to contain the flow of water within the channel but taking into account the natural floodplain and flow regime of the river.

Flat terrain of the proposed relocation site of Brgy. Caatihan (*Looking north; GPS location: 7°53'54.128"N 126°17'5.911"E)*

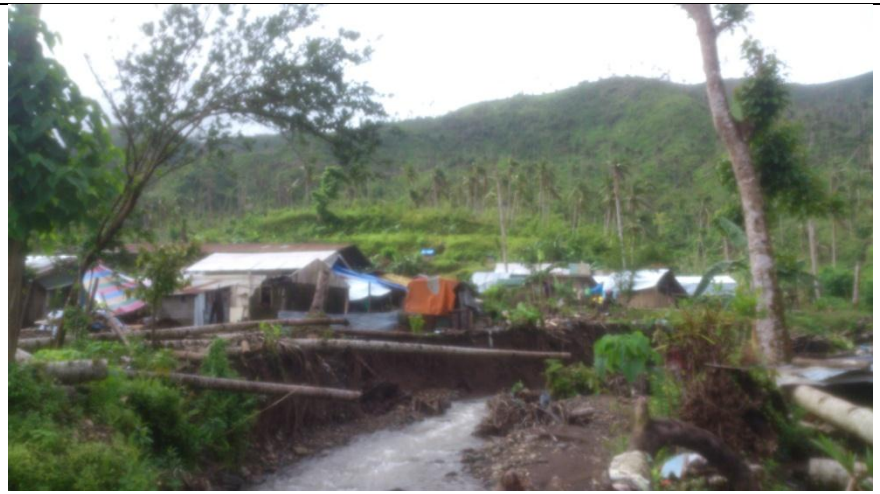
CABASAGAN			
Daha	Moderate	None	• Observe signs of ground movement such as cracks and seepages • Report information to MGB and LGU
Ipil-ipil	High	Moderate (High in areas close to Cabasagan River)	• Relocation of the barangay center and majority of the houses as the present location is an old landslide deposit • Monitor slopes located upstream of Magtagum Aug Creek specially during heavy rains to verify if any damming of creek waters may occur from slope failures along flanks • Establish early warning systems and signage • Observe signs of ground movement such as tension cracks, seepages and others • Monitor rapid rise in river waters and sudden increase in

			turbidity
Narra	Low	High near the banks of Cabasagan River	• Relocation of houses near Cabasagan bridge that are moderately susceptible to flooding
Panaohon	Very High	None	• Relocation of majority of the residents as the area is severely affected by gully erosion which caused slope failures in several areas • Establish warning signs along roads and other areas
Mahayahay	Moderate	None	• Observe signs of ground movement such as cracks and seepages • Report information to MGB and LGU
Buko-buko	Moderate	None	• Observe signs of ground movement such as cracks and seepages • Report information to MGB and LGU

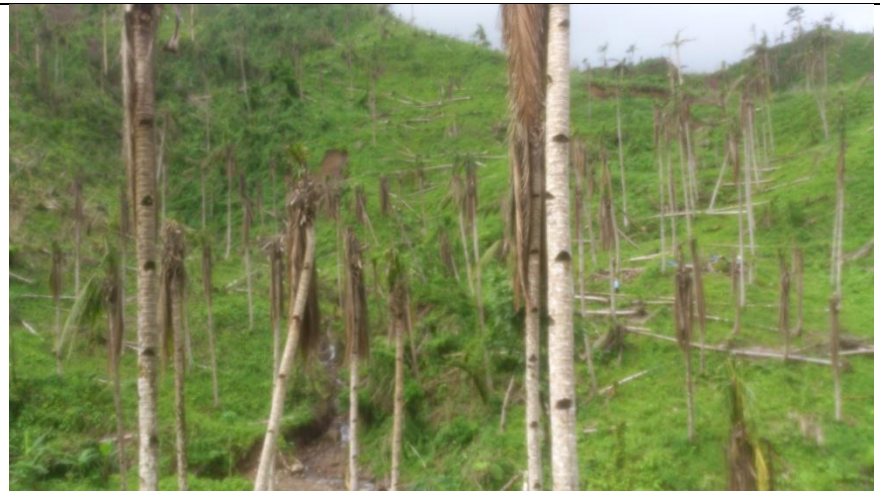
Po. Mahayay, Brgy. Cabasagan with moderate slopes



Po. Ipil-ipil, Bry. Cabasagan. Photo taken looking downslope towards the north



Accelerated river bank erosion in Po. Ipil-ipil, Brgy. Cabasagan



Landslide along flanks of Magtagum Aug Creek in Po. Ipil-ipil, Brgy. Cabasagan

PROPOSED RELOCATION SITE

Site 1. This proposed relocation site is intended for the residents of Po. Ipil-ipil, Brgy. Cabasagan and comprises approximately 2 hectares of land owned by Jurie Cabrera. The proposed site located in Po. Narra is roughly centered on the geographic coordinates 7º50'30.8" north latitude and 126º22'10.5" east longitude. At the time of the inspection, several residents have already moved within the area and some bunkhouse units have been constructed on the property. The proposed site is characterized by relatively flat terrain with very minor topographical variation. It is situated adjacent to the national highway and is approximately 330m from the main channel of Cabasagan Creek. Interviews with the local residents reveal that riverine flood waters have not reached the proposed site in previous flood events. At present, the vegetation within the proposed relocation site is primarily wild grasses and shrubs with few live coconuts.

Recommendations:

- Appropriate drainage systems must be established within the residential site to properly channel surface runoff.

Site 2. This site in Po. Narra is the second proposed relocation area within Brgy. Cabasagan. This property is intended for the residents of Po. Panaohon, Brgy. Cabasagan and is about 3 hectares in land area owned by Mr. Winifredo Bigoli. This property is located approximately 600m road distance south of the previous relocation site. It is centered within the geographic coordinates 7º50'28.4" north latitude and 126º22'14.6" east longitude. The property is characterized by moderately sloping terrain with the eastern central section traversed by the national highway. The western boundary of the property is composed of moderate to gentle slopes grading into the flat regions of the barangay. The section of the property that have been cut by the national road experiences some slope failures along this cut section. The eastern side is composed of gentle to moderate slopes going towards the coastal region of the barangay.

Recommendations:

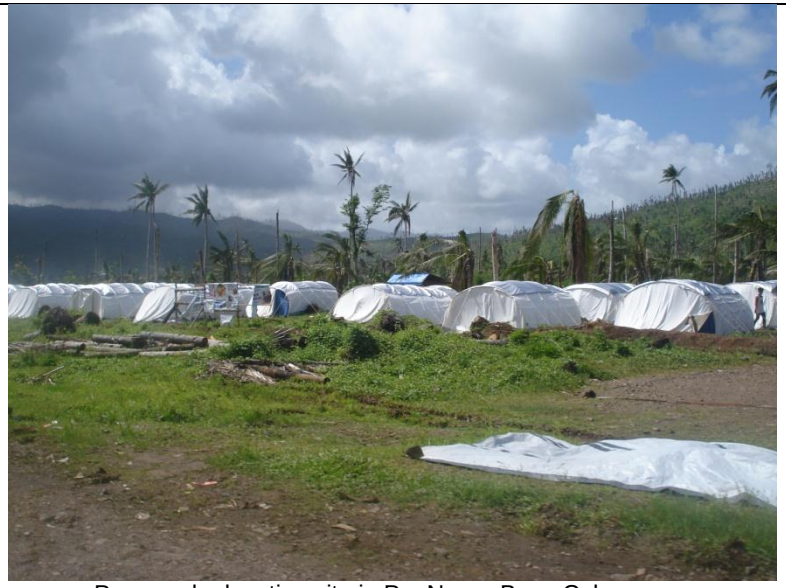
- Appropriate no build buffer zones should be maintained from the edge sloping areas and road cuts of no less than 5 meters. In additional, road allowance which is set at 15m from the center line of the national highways should not be utilized as residential areas.
- Proper drainage networks must be established within the residential areas to draw away storm waters as well as prevent ponding of water

Site 3. This relocation site in Po. Mahayahay is intended for residents of Brgy. Cabasagan and covers approximately 2 hectares. The property is owned by Mr. Ronaldo Doran. It is roughly centered on the geographic coordinates 7º50'14.5" north latitude and 126º22'28.9" east longitude. At present, several houses have already been built in this area.

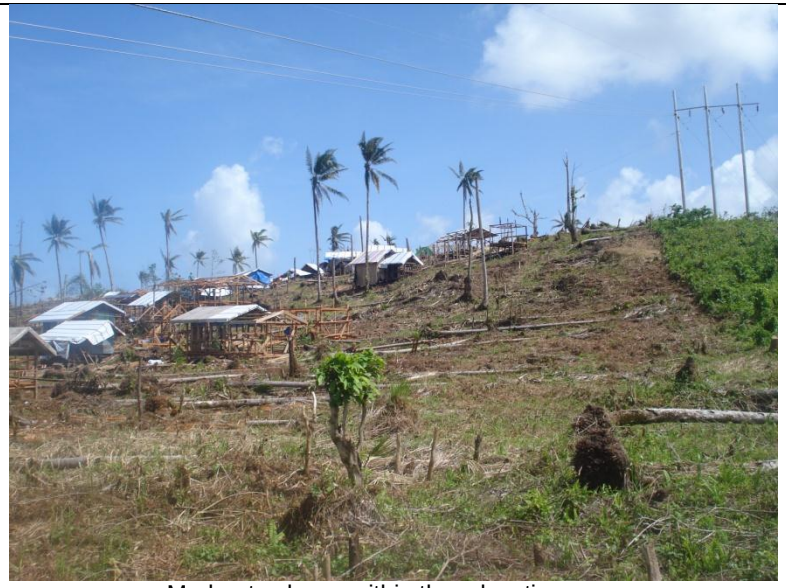
The site is characterized by moderate slopes with a wide sloping ridge area generally trending north south. A shallow valley section bounds the western side of the property while the eastern flank of this ridge is composed of moderately sloping terrain. Vegetation within the area is chiefly composed of wild grasses and shrubs. Drainage is mostly composed of surface runoff channel into the shallow valley section.

Recommendations:

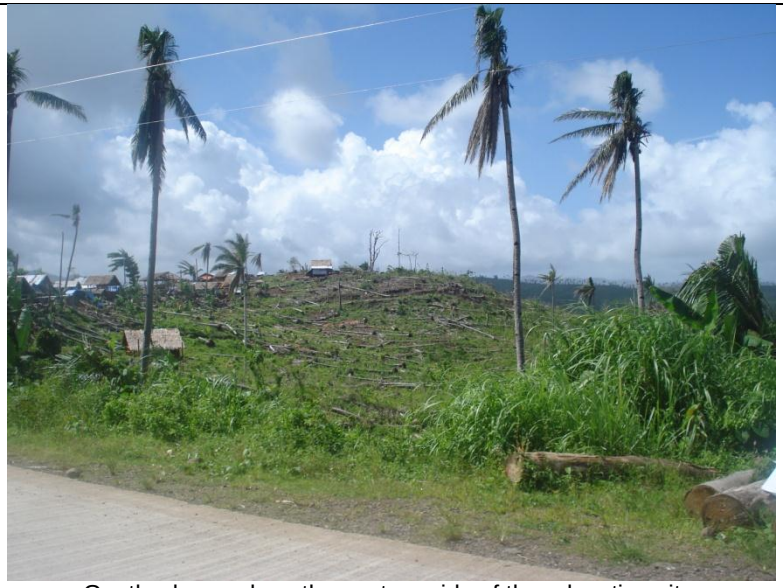
- No build buffer zones should be established along the some steep sections of the property.
- Drainage systems within the residential areas must be established to ensure proper removal of storm waters within the housing section.
- Road allowances from the center of the national highway should be maintained as not residential zones.



Proposed relocation site in Po. Narra, Brgy. Cabasagan

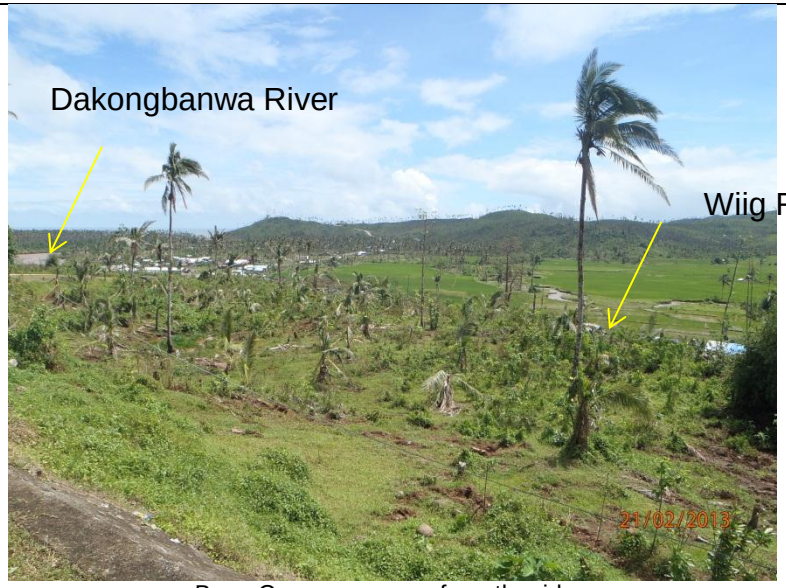


Moderate slopes within the relocation area

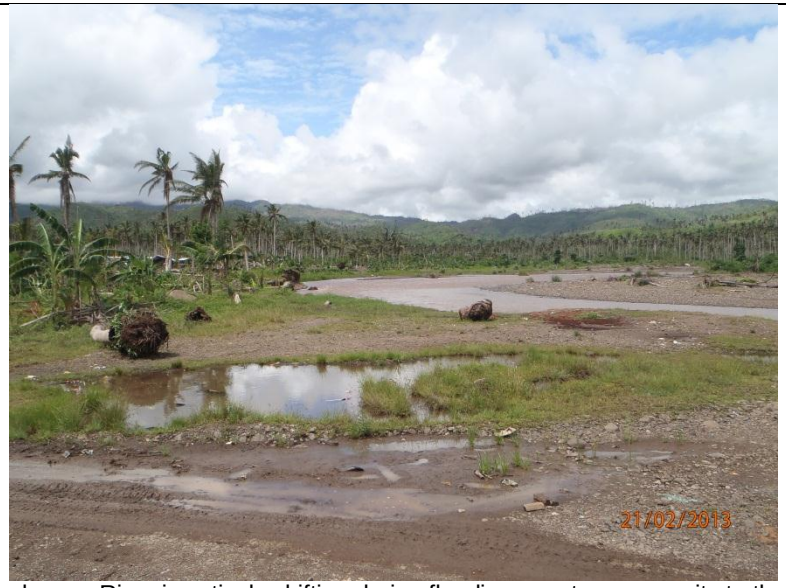


Gentle slopes along the eastern side of the relocation site

CARMEN			
Lambog	Moderate	Low	Surface runoff from Cayawan flows towards Lambog; flood height is about 0.3 meters; cobbles and gravels are also carried by surface runoff towards the main highway • Installation of proper drainage system • Building of flood-adaptive houses such as houses on stilts
Durian	Moderate	High	The areas are situated on a floodplain prone to flashflood and sheetflood; drained by two major river system (Wiig River and Dacongbanwa River); active shifting of river channel observed; Flood height in worst case scenario is about 2 meters; scouring of river bank present • Immediate relocation • Monitor increase in turbidity and soil content of rivers • Identification of evacuation site that is easily accessible to the residents during flooding event while awaiting relocation
Mangga	None	High	
Langka	None	High	
Bayabas	None	High	
Macopa	None	High	



Brgy. Carmen as seen from the ridge
(Looking southeast; GPS location: 7°52'15.932"N 126°21'5.482"E)



Dakongbanwa River is actively shifting during flooding events, community to the left is Po. Mangga (*Looking west; GPS location: 7°52'14.766"N 126°20'58.944"E)*

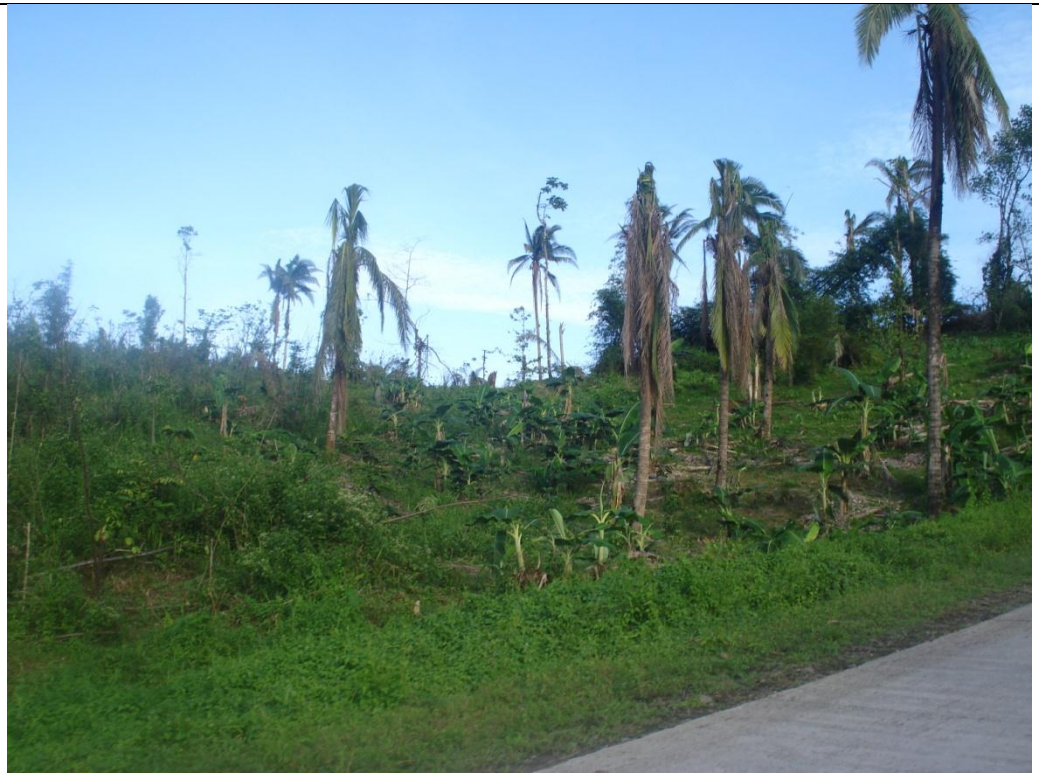
PROPOSED RELOCATION SITE

Site 1. This proposed relocation site in Po. Durian is comprised of two adjacent areas, one is a 3-hectare property owned by Luisa Ala and the adjacent property of John Cantilla which is approximately 1 hectare in area. The site is located within the geographic coordinates 7º52'0.3" north latitude and 126º20'44.0" east longitude and is just a few meters upslope from the current barangay center.

The property is characterized by moderate slopes which grades into the flood plain currently being occupied by the barangay centers. It is on top a low elevation ridge roughly trending southwest northeast and is traversed at the central part by the national highway. At the time of the inspection, vegetation mainly consist of wild shrubs and grasses with very few tree species. At the eastern edges of the property, across the national highway, some residents have erected temporary dwellings close to the sloping banks of the creek flowing parallel to the national highway.

Recommendations:

- Establish proper drainage systems in the future residential communities to efficiently drain storm waters from the slopes.
- Appropriate ground preparation and site grading must be implemented to maximize the usable space in the area as well as attain optimum ground stability.
- A section located south of the national highway should not be utilized as residential area as this portion shows indications of mass movement and is within a gully which serves as a channel for water that drain from the upslope region.

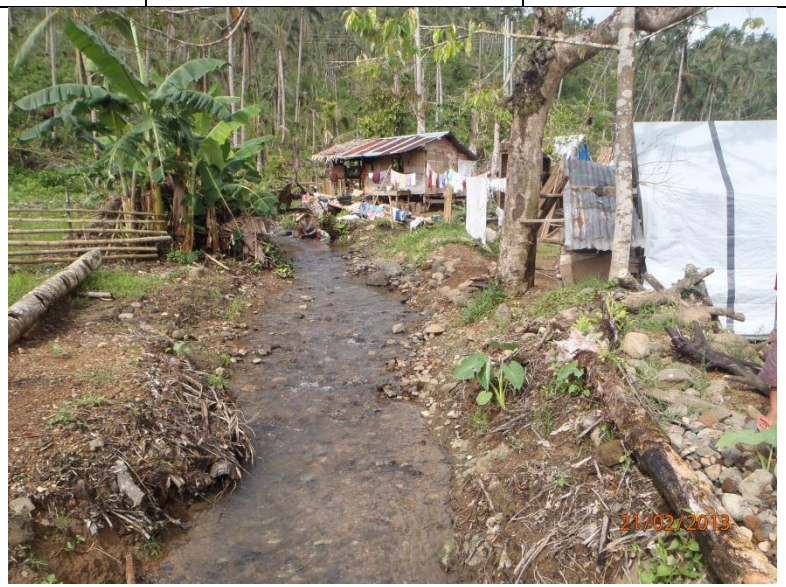


Moderate slopes within the central portion of the proposed relocation site

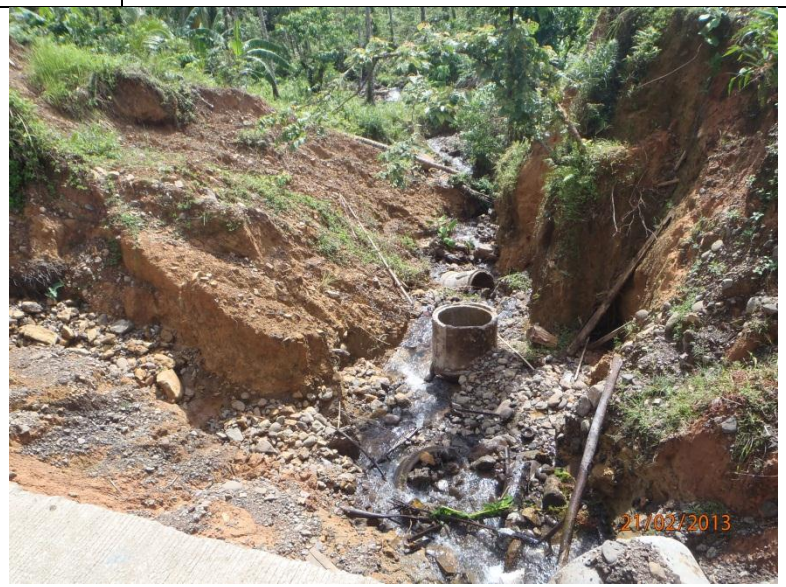
CAWAYANAN			
Baclinan 1	Moderate	Moderate	Sheetflooding is experienced on flat areas near Dakongbanwa River • Monitor presence of landslides along the road • Establish flood-adaptive houses
Baclinan 2	High to Very High especially along roadcuts and drainage hollows	None	Earthflow noted at the bend along the main highway resulting to damage of culverts and removal of lateral support at the eastern side of the road • Install culverts that can accommodate the maximum surface runoff • Install warning signage along the road • Install slope protection
Baclinan 3	None	High	Flood height is about 1.3 meters • Monitor increase in turbidity and soil content of creek

			• No development should be added to the flood-prone areas but instead be utilized only for agricultural purposes
Tigbawan	Moderate	High	A perennial creek bounds the southern portion of the sitio; during heavy rains, water from the creek overflows towards the north inundating the houses in addition to surface runoff from the surrounding hills; floodwater carries debris mostly gravel and cobble with few boulders; type of flooding is sheet flood; about 60 houses are affected; During typhoon Pablo, flood height was more than 1 meter • Installation of proper drainage system that can accommodate maximum surface runoff and direct it to proper repositories • Flood-adaptation is advised • Install flood protection such as gabions to confine water within its channel during heavy rain
Purok 1	*Moderate*	*None*	• Installation of proper drainage to contain and dispose surface runoff water and minimized the effect of slope wash and slope erosion. • Bioengineering measures should be undertaken to minimized slope wash and slope erosion. • Buffer/easement zone at least 5 meters from the steep slope should be undertaken. • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Purok 2	*Moderate*	*None*	• Installation of proper drainage to contain and dispose • surface runoff water and minimized the effect of slope wash and slope erosion. • Bioengineering measures should be undertaken to minimized slope wash and slope erosion. • Buffer/easement zone at least 5 meters from the steep slope should be undertaken. • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Purok 3	*Moderate*	*None*	• Installation of proper drainage to contain and dispose surface runoff water and minimized the effect of slope wash and slope erosion. • Bioengineering measures should be undertaken to minimized slope wash and slope erosion. • Buffer/easement zone at least 5 meters from the steep slope should be undertaken.

			• Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Purok 4	*Moderate*	*None*	• Installation of proper drainage to contain and dispose surface runoff water and minimized the effect of slope wash and slope erosion. • Bioengineering measures should be undertaken to minimized slope wash and slope erosion. • Buffer/easement zone at least 5 meters from the steep slope should be undertaken. • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities



Perennial creek in So. Tigbawan which inundates the whole sitio during heavy rains (*Looking west; GPS location: 7°53'55.168"N 126°21'12.006"E)*

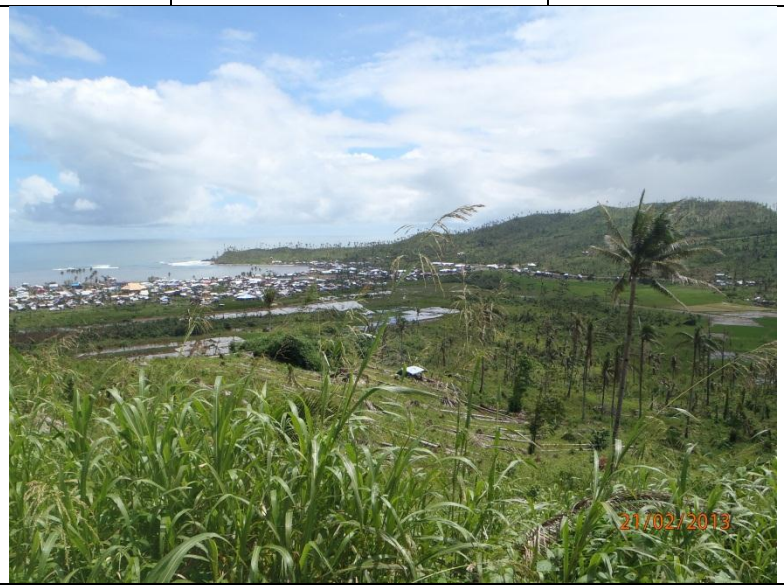


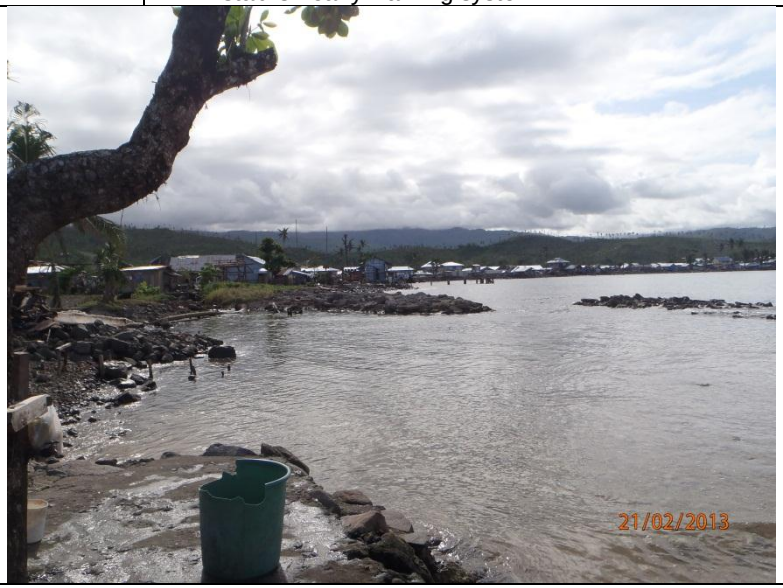
Earthflow and gulley development in Po. Baclinan 2 along the national highway (*Looking southeast; GPS location: 7°53'29.765"N 126°21'6.383"E)*

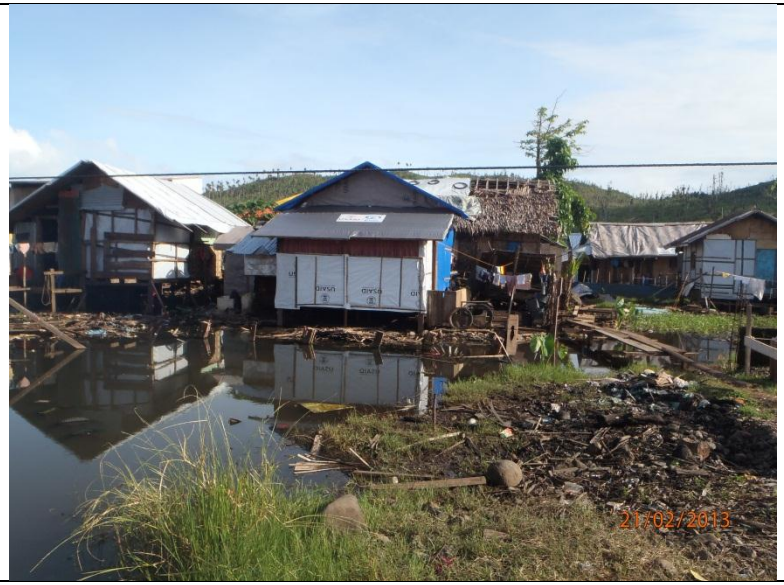
Proposed Relocation Site

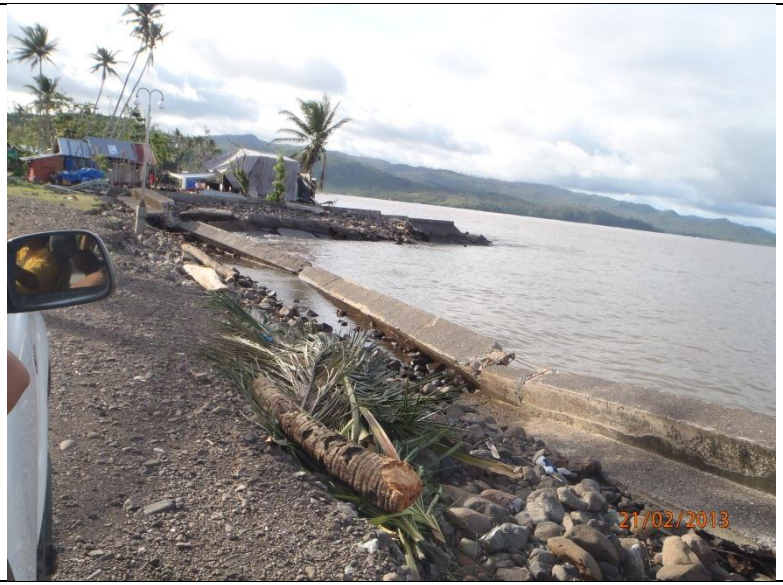
The proposed relocation site the present Purok 3 and 4 of Barangay Cawayanan. This property is owned by the local government having more or less 1.7 hectares of land area. The general topography of the area is nearly flat to gently rolling to moderately steep slope terrain. It is presently occupied by 79 household, 39 of which is from Purok 3 and 40 is from Purok 4. The soil material observed in the area is generally orange brown clay soil. A slumped material was also delineated on the north dipping northwards. Based on field ocular inspection, the ***proposed relocation site is suitable for housing development***; however, the following recommendations should be considered, to wit: 1). Considering the easily weathered soil material of Purok 3 and 4, bioengineering methods such as planting trees at the slopes and on flat ground surface (or Bermuda grasses on flat grounds) should be done to minimized effect of soil erosion in the area. 2) Proper drainage should be installed to efficiently channel and dispose surface run-off water. 3). Conservative buffer zone/easement at least 5 meters from the slope should be employed.

POBLACION			
Dahlia	Low	High	
Maripusa	Moderate		• Observe signs of ground movement such as cracks and seepages • Report to MGB and LGU
Santan	Low	Low	• Monitor rapid rise in canal waters
Rosal	Low	High	• Relocation of residents close to the shoreline
Camia	Low	High	• Relocation of residents close to the shoreline
Kalipayan	Low	High	• Relocation of residents close to the shoreline
Sampaguita	Low	Moderate	• Establish early warning systems
Daisy	Low	Moderate	• Establish early warning system



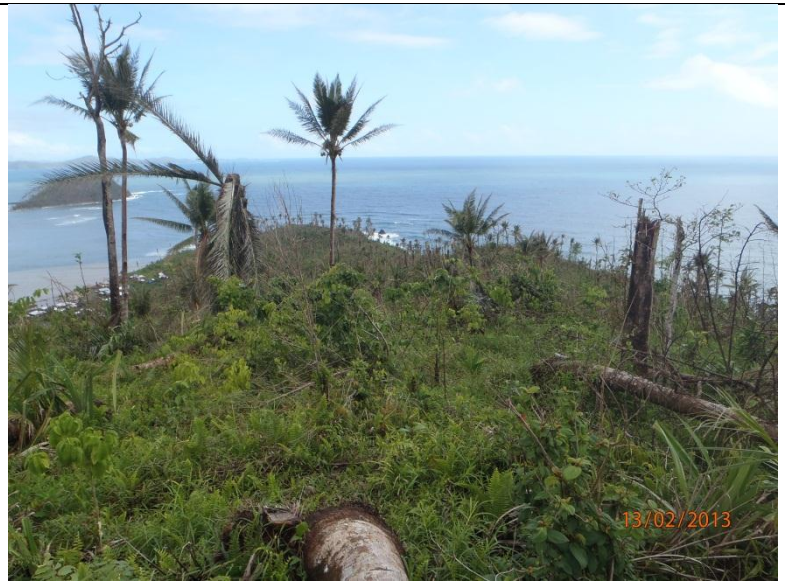
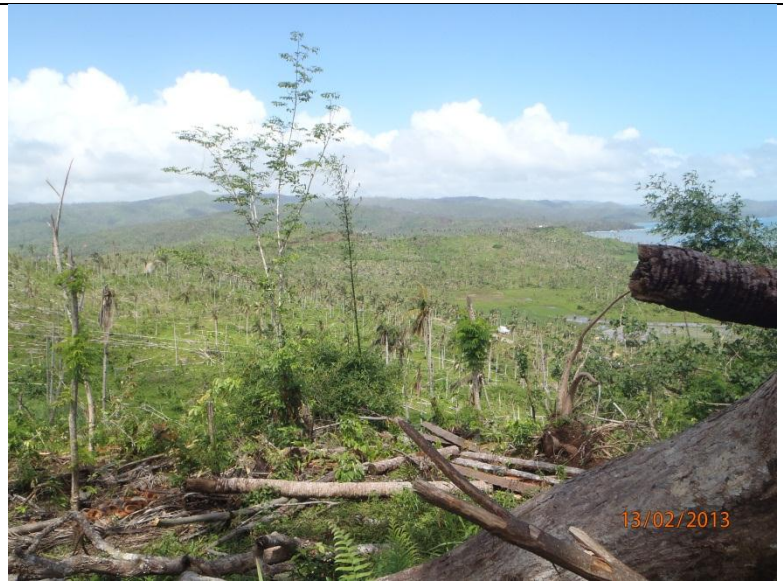




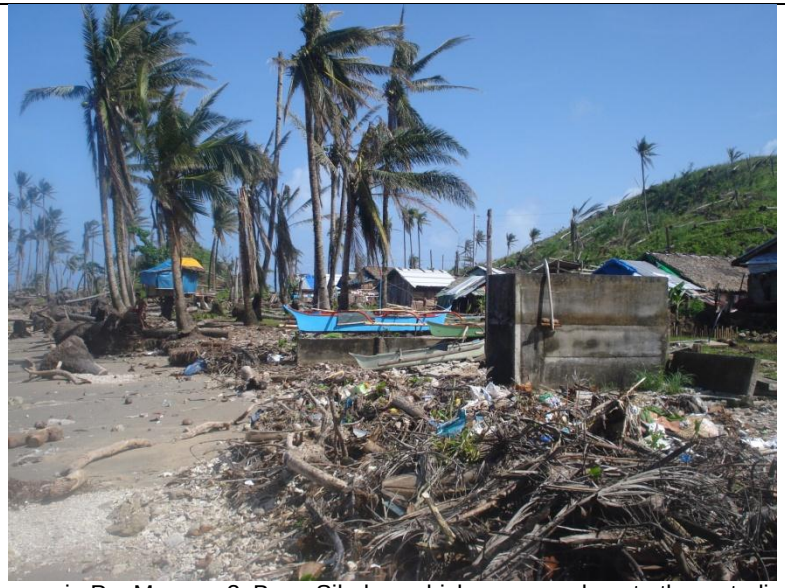


PROPOSED RELOCATION SITE

The proposed site for relocation of Poblacion includes the slopes surrounding the whole Brgy. Poblacion from the Point (Punta) in the east to the Point (Punta) to the west where the detachment is located. Based on field assessment, the area which can only be developed into a resettlement site are the slopes in the east to the moderately sloping terrain south of the Poblacion. The rest of the area is not suitable for development due to the presence of active slope failures. The gently sloping slopes to the west are old landslide deposits which are also susceptible to landslides. The area is characterized by gently sloping to moderately steep slopes underlain by volcaniclastic rocks and materials. Boulders of Basalt were noted to be scattered in the area. The sites approved are in Po. Santan Brgy. Poblacion with land area of 180,382 sq.m. and 230,204 sq.m. awarded to Mr. Nolan V. Castillones and six (6) other farmer beneficiaries and Reissa Madonna Kho Su and eight (8) other farmer beneficiaries, respectively.

 Relocation site (Castillones et al property) (*Looking north east; GPS Location: 7°51'46.597"N 126°22'40.028"E)*	 Relocation Site (Uy et al property) (*Looking northwest; GPS location: 7°51'48.649"N 126°22'7.638"E)*

SIBAHAY			
Mangga 2	Low	Low (High very near the shoreline)	• Relocate houses situated very close to the shoreline as progressive coastal erosion have been observed
Mangga 1	Low	Low (High very near the shoreline)	• Relocate houses situated very close to the shoreline as progressive coastal erosion have been observed
Caimito	Very High		• Relocate residents located downslope of the present slope failure along highway road cut across Sibahay Elementary School • Constantly monitor slopes especially during heavy rainfall events • Develop early warning systems including signage
Bong-on	Moderate	None	
Durian	High	None	• Monitor signs of mass movement such as cracks, seepages etc. • Report events to concerned agencies and LGU's
Marang	High	None	• Relocate residents specially houses built along edges of very steep slopes
Manat	Low	High (near Manat River)	• Establish early warning systems and observed rapid increase in water levels as well as turbidity • Relocate houses within flood prone areas proximal to Manat River



Houses in Po. Mangga 2, Brgy. Sibahay which are very close to the waterline. Shoreline exhibits active coastal erosion

Po. Marang, Carabatuan, Brgy. Sibahay

PROPOSED RELOCATION SITES

Site 1. This proposed relocation in located within the geographic coordinates 7º49'26.2" north latitude and 126º24'2.1" east longitude and is within the political jurisdiction of Po. Bong-on, Brgy. Sibahay. The proposed property is owned by 9 people, namely Bonifacio Sufino, Nestor Piras, Dominador Felino, Jaime Felino, Bienvinido Lozano, Nonoy Cabrera, Enteng Sufino, Orlando Condesa and Amado Moralde, each with 1.66 hectares for a total agglomerate area of 14.94 hectares.

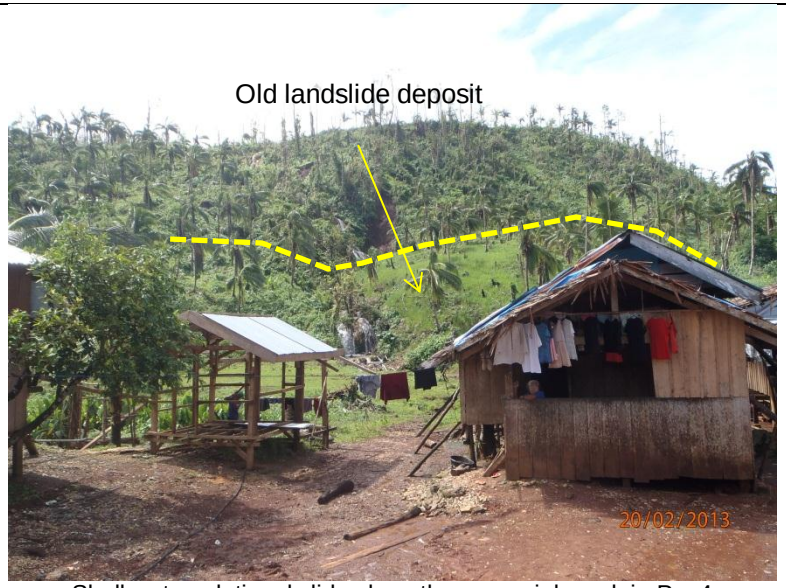
The property is located in a relatively flat region with some sections moderately sloping to undulating terrain. Majority of the property are flat in topography with shallow valleys in between. The northern boundary is marked by a small moderately sloping hill. Access into the proposed site is through an old logging road which connects the proposed area to the national highway. A shorter way can be taken, however the trail will cut through very steep terrain from the national highway.

Recommendations:

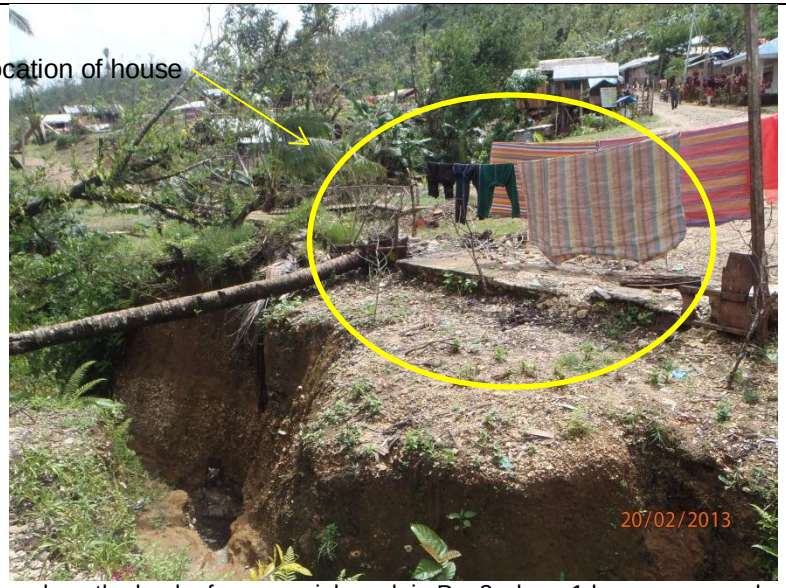
- Strict implementation of no build buffer zones along edges of slopes considering the elevated location of the relocation site.
- Drainage networks should be properly designed and established in order properly channel storm waters and avert flooding and inundation in the lower elevation valley sections.

Flat terrain comprising majority of the area in the proposed relocation

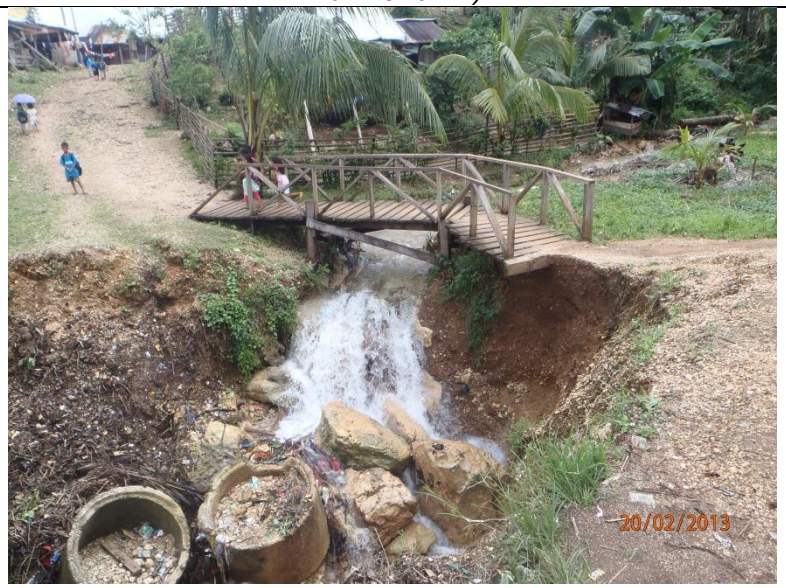
SIMULAO			
Purok 1	The area where the houses are situated has low susceptibility but the surrounding slopes have moderate to high susceptibility	Moderate along Tugop Creek	River banks/slopes proximal to Simulao River have very high susceptibility to landslide while the upper portions are high to landslide • Monitor progress of existing landslide/presence of new slope failures • Report to MGB or other authorities on critical conditions for appropriate action • Immediate removal of debris material that may dam creeks/natural drainages Scouring along the banks of Tugop creek observed; flood height during typhoon Pablo was 0.5 m; floodwater subside after 1 hr; type of flooding is flashflood • Installment of creek bank protection to prevent further scouring • Deepen channel of creek particularly near P1 and P2 to accommodate maximum surface runoff • Installation of culverts • Relocation of houses very near to the creek channel
Purok 2		Moderate along Tugop Creek	
Purok 3		Moderate along Tugop Creek	
Purok 4		None	



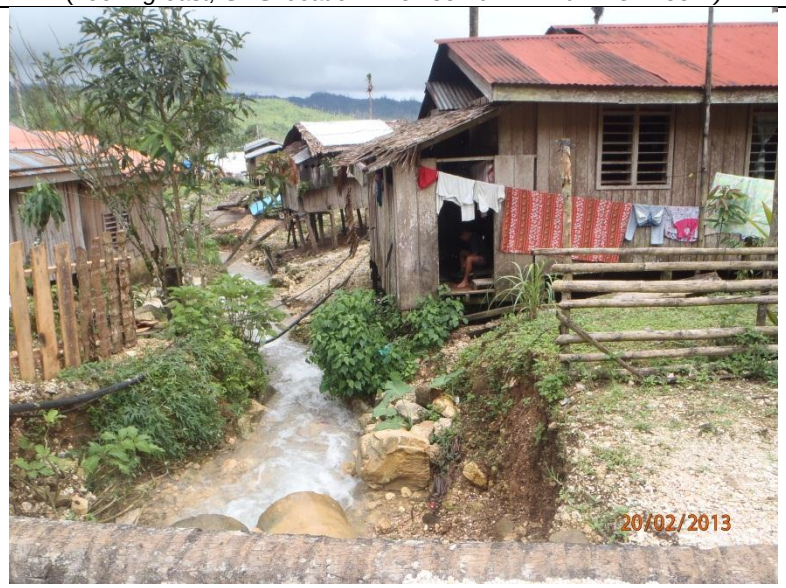
Shallow translational slide along the perennial creek in Po. 4
(*Looking south; GPS location of observation point: 7°52'53.203"N 126°14'52.91"E)*



Scouring along the bank of a perennial creek in Po. 3 where 1 house was washed away during Typhoon Pablo.
(*Looking east; GPS location: 7°52'55.404"N 126°14'57.253"E)*



Washed-out culverts along Tugop Creek. Active scouring noted
(*Looking east; GPS Location: 7°52'55.387"N 126°14'58.213"E)*



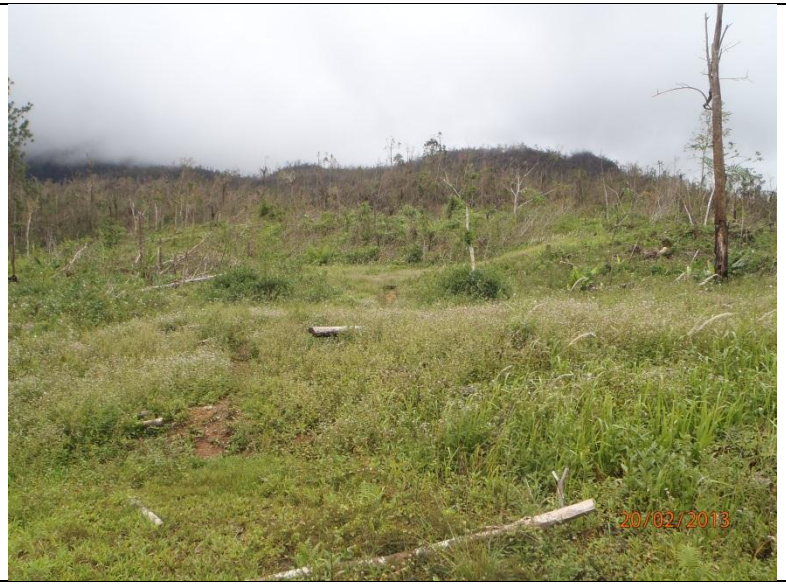
Houses in Po. 2 proximal to Tugop creek which are regularly flooded (0.5 m flood height) are subject for relocation
(*Looking north; GPS Location: 7°52'53.365"N 126°15'0.32"E*)

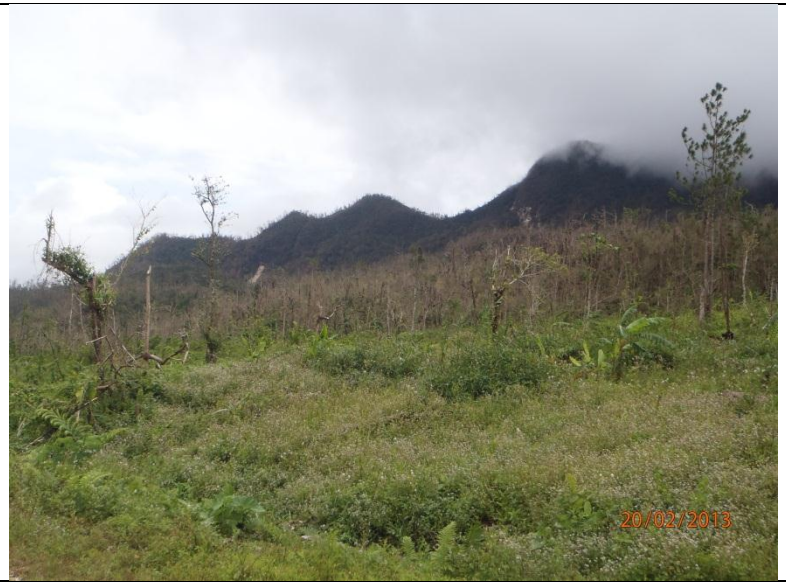
PROPOSED RELOCATION SITES

Site 1. The proposed relocation site is located in Purok 2 and centered approximately in geographic coordinates 7°52'58.383"N and 126°15'2.543"E . It has a land area of about 5 hectares owned by Marjun Latiban. It is characterized by flat to undulating terrain and underlain by limestone and clay as shown in a 2 meter deep pit dug within the property. Boulders of coralline limestone were also noted to be scattered in the area. Ponding is also observed which indicates low infiltration of water due to the type of the underlying material composed generally of clayey soil. Based on the inspection, the area can be utilized as a relocation site however proper drainage system should be installed in the area that can accommodate maximum surface runoff from the surrounding areas. The lower section east of the property is not recommended for development as this serves as a natural drainage of the area.

Site 2. The proposed site (Tarok area) is situated on an elevated area around 700 meters (linear distance) southeast from the barangay proper with geographic coordinates of 7°52'36.317"N and 126°15'13.948"E at 520 masl elevation. The property is owned by Mr. Willy Ombaogan with land area of about 6 hectares. The area is characterized by flat to undulating terrain with its vicinity drained by several intermittent and perennial creeks. The underlying material is composed of coralline limestone. The area is suitable for land development particularly resettlement site however it is advised that considerations should be given in the drainage system of the area as presence of ponds and lakes were observed in the vicinity. The area should also be inspected if there is presence of caves, cavities or sinkholes underneath prior to land development to mitigate occurrence of land subsidence in the future.

Site 1. Relocation Site (*Looking northeast; GPS location: 7°52'58.625"N 126°15'3.078"E)*





Site 2. Tarok Relocation Site (*Looking south(left) and southeast (right); GPS Location: 7°52'36.333"N 126°15'13.852"E)*

SAN JOSE			
Purok 1	*Low*	*Moderate* to *High*	Purok 1 is situated on a sand bar/fluvial deposit of Caatihan and Paumpocon River. This area is periodically inundated with flood waters that usually range from 1.0 to 1.4 meters of flood height. • Relocation of the entire Purok 1 • No further development (eg. residential) should be allowed in these areas. • Monitor slope failures along the Caatihan River that may possibly result to damming and eventually flashflooding. • Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content)
Purok 2	*Low* but *Moderate* towards western slopes	*Low* to *Moderate* but High adjacent to Caatihan River	Like Purok 1, Purok 2 is situated on a sand bar/fluvial deposit of Caatihan and Paumpocon River. These areas are periodically inundated with flood waters that usually range from 0.5 to 2 meters of flood height. • Relocation of entire Purok 2 • No further development (eg. residential) should be allowed in these areas. • Monitor slope failures along the Caatihan River that may possibly result to damming and eventually flashflooding • Monitor rapid increase/decrease in creek/river water

			levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Purok 3	*Low* but *Moderate* towards western slopes	*Moderate* but High adjacent to Caatihan River	Purok 3 is also located on a sand bar/fluvial deposit of Caatihan and Paumpocon River. This area is periodically inundated with flood waters that usually range from 0.5 to 2 meters of flood height. Recent Typhoon Pablo (December 4, 2012) destroyed 2 houses proximal to Kaatihan River. Last January 11, 2012, 6 houses were also washed out due to flashflood of Caatihan River. San Jose Elementary school also experienced a maximum of 0.7 meter of flooding recorded adjacent to the barangay road. • Relocation of entire Purok 3 • No further development (eg. residential) should be allowed in these areas. • Monitor slope failures along the Caatihan River that may possibly result to damming and eventually flashflooding • Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Purok 4	*Low*	*Moderate* but High adjacent to Caatihan and Paumpocon River	Like the rest of barangay proper, Purok 4 is situated on old sand bar/fluvial deposit of Caatihan and Paumpocon River. This area is periodically inundated with flood waters that usual range from 0.5 to 1.4 meters of flood height. Creek near the wet market experience of flood flight greater than 1.5 meters. • Relocation of entire Purok 4 • No further development (eg. residential) should be allowed in these areas. • Monitor slope failures along the Caatihan River that may possibly result to damming and eventually flashflooding • Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Babay	*Low* but *high* at the southern slopes	*Moderate but High* adjacent to Kaatihan River	• Declare the low-lying area proximal to Caatihan River as no habitation zone • Design houses on stilts to allow continuous flow of water during flooding event • Buffer/easement zone at least 5 meters from the steep

			slope should be undertaken. • Proper slope mitigation (benching, riprap, etc.) and bioengineering measures should be employed on the southern slope to minimized the effect of slope wash and slope erosion that may lead to slope destabilization. • Install proper canals to confine surface run-off from natural drainages or drainage hollows
Sitio Botigan	*High* but *critical* in active landslide bodies	*None*	Sitio Botigan is situated on a rugged terrain with elevation ranging from 300 to 500 meters above sea level. Numerous landslide scarps and active landslides were delineated going towards and/at the vicinity of the main Sitio. The barangay roads have been progressively destroyed by surface runoff water especially along deep valley. These valleys were noted to have debris materials indicating flashflooding occurrence in the area. The main Sitio possesses threat to landslide considering the loosely, unconsolidated, and thick, soil and regolith material in the area. • Relocation of entire Sitio Botigan • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Bongcoan	*Moderate* but *High* at the northern and eastern slopes	*None*	• Installation of proper drainage to contain runoff water and minimized the effect of slope wash and slope erosion. • Bioengineering measures should be undertaken to minimized slope wash and slope erosion • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Caanislagan	*Low* but *Moderate* at the adjacent slopes	*Low*	• Design houses on stilts to allow continuous flow of water during flooding event • Conservative buffer zone at least 5 meters from Caanislagan creek and to other creeks present should be undertaken. • Install proper canals to confine surface run-off from natural drainages or drainage hollows • Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Cayawan	*Moderate* but *High on the adjacent slopes*	*None*	• Installation of proper drainage to contain and dispose surface runoff water and minimized the effect of slope wash and slope erosion. • Bioengineering measures should be undertaken to minimized slope wash and slope erosion. • Observe for and/or monitor for presence of mass

			movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Madugos	*Low* but *Moderate* to *High* at the adjacent slopes.	*High* adjacent to Kaatihan River	• Relocation of entire Sitio Madugos • Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Owabangon	*Moderate* but *High* at southern, southwestern, northeastern and eastern slopes.	*Low* at Libog Creek	• Design houses on stilts to allow continuous flow of water during flooding event • Conservative buffer zone at least 5 meters from Caanislagan creek and to other creeks present should be undertaken. • Install proper canals to confine surface run-off from natural drainages or drainage hollows • Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities
Sitio Sinayan	*Low* but *Moderate to High* at the northern slopes	*High* adjacent to Mikit River	• Monitor rapid increase/decrease in creek/river water levels, possibly accompanied by increase turbidity (soil content) • Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); Report situation to MGB office and the municipal authorities

Proposed Relocation Site

The proposed relocation site is located at Purok 2 of Barangay San Jose. It is approximately centered by the geographic coordinates of 07°52'31.0" north latitude and 126°20'01.0" east longitude. The property is owned by Ernesto de Jesus and has more or less 6 hectares of land area. The general topography of the area is moderate steep hill and is adjacent to Paumpocon River at the south. Based on ocular inspection, ***the relocation site is suitable for housing development***; however the following recommendation should be strictly followed upon developmental stage to ensure safety and stability, to wit: 1). Cut and filling and proper grading plan should be done to maximized the areas to be used for house settlement. 2). Proper engineering and bioengineering measures should be employed in the cut and filled areas to ensure stability of the slope modified. 3) Some portions of the lot which is nearly flat to gently undulating terrain at the south is not suitable for development as these areas are prone to flood inundation considering the adjacent Paumpocon River. 4). Conservative buffer zone at least 5 meters from steep slope should be undertaken. 5). Slope protection such as riprap/ bank protection at the footslope of the hill adjacent to Paumpocon river is highly advice to prevent undercutting of footslope material.

Suggested Relocation Site

1) Nearly flat to moderate slope topography with geographic coordinates of 7°52'28.0" north latitude and 126°19'36.0" east longitude having approximately 6.2 hectares of land area is located at the left portion of the barangay road going to Sitio Owabangon.
2) Moderate slope topography with geographic coordinates of 7°53'38.0" north latitude and 126°17'36" east longitude.

It should be noted that these susceptibility ratings were arrived at as of this field assessment. However, the rating could advance (e.g., from low to moderate, and moderate to high). Hence, the MGB constantly recommends strict and continuous monitoring by the barangays.

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